COURSE OUTLINE
Last Revised and Approved: 10/12/2017

CHEM 140 - PREPARATION FOR GENERAL CHEMISTRY: FOR SCIENCE MAJORS

Units Lecture	3.00	**Units Lab**	1.00	**Units Total**	4.00
Lecture Weekly Contact Hours	3.00	**Lab Weekly Contact Hours**	3.00	**Total Weekly Contact Hours**	6.00
Lecture Weekly Outside of Class Hours	6.00	**Lab Weekly Outside of Class Hours**	0.00	**Total Weekly Outside of Class Hours**	6.00
Total Semester Hours	96.00 - 108.00	**Total Outside of Class Hours**	96.00 - 108.00		

Typically Offered: Fall, Spring, and Summer - F,SP,SU

COURSE DESCRIPTION
This introductory chemistry course focuses on developing problem-solving skills needed for success in CHEM 150. It emphasizes the application of the scientific method, modern ideas concerning atomic structure and chemical bonding, the periodic table and its relationship to chemical properties, principles of stoichiometry including chemical ratio calculations, chemical nomenclature, properties of the states of matter, and chemical reaction principles. The laboratory component of this course provides direct participation in experiments, demonstrations, learning activities and discussions related to fundamental concepts in chemistry. (Formerly CHEM 108) UC CREDIT LIMITATION: Credit for CHEM 115/CHEM 115H or CHEM 140; No credit if taken after CHEM 150/CHEM 150H.

ENROLLMENT RESTRICTIONS
Prerequisite
MATH 64 or eligibility determined by the math placement process or

Not open to students with prior credit in
CHEM 150 or CHEM 150H; CHEM 108

Enrollment Limitation
MATH 64

OUTLINE OF COURSE LECTURE CONTENT
The course lecture will address the following topics:

I. Introduction to chemistry
A. Chemistry in the world around us
B. Scientific method.

II. Measurement and problem solving
A. Scientific notation
B. Significant figures
1. Determining significant figures
2. Addition and subtraction
3. Multiplication and division
4. Combined operations.
C. Basic units of measurement
D. Problem solving and unit conversions (dimensional analysis)
E. Density: using density as a conversion factor.

III. Matter and energy
A. Classifying matter by its state: solids, liquids, and gases
B. Classifying matter by its composition: elements, compounds, and mixtures
C. Physical and chemical properties
D. Physical and chemical changes
E. Conservation of mass
F. Energy
1. Units of energy
2. Energy changes (exothermic and endothermic).
G. Temperature
1. Fahrenheit, Celsius, and Kelvin scales
2. Conversions between scales.

IV. Atoms and elements
A. Protons, neutrons, and electrons
B. Atomic mass, atomic mass unit, and charge
C. Atomic number, atomic symbol, and element names
D. Periodic table
1. Periodic law
2. Metals, nonmetals, and semimetals (metalloids)
3. Main-group and transition elements
4. Group names.
E. Ions
1. Determining charge of an ion
2. Predicting charge using the periodic table.
F. Isotopes
1. Isotopic abundance
2. Average atomic mass.

V. Molecules and compounds
A. Constant composition
B. Chemical formulas
C. Pure substances
1. Atomic elements
2. Molecular elements
3. Molecular compounds
4. Ionic compounds.
D. Formulas for ionic compounds
E. Naming ionic compounds
1. Type I
2. Type II
3. Polyatomic ions.
F. Naming molecular compounds
G. Naming acids
H. Formula mass.

VI. Chemical composition
A. Mole concept
1. Avogadro's number
2. Molar mass.
B. Chemical formulas as conversion factors: relating elements to compounds
C. Mass percent
1. Empirical formula
2. Molecular formula.

VII. Chemical reactions
A. Evidence of a chemical reaction
B. Chemical equations
C. Balancing chemical equations
D. Aqueous solutions and solubility: solubility rules
E. Precipitation reactions
F. Acid-base reactions (neutralization)
G. Gas evolution reactions
H. Classifying chemical reactions.

VIII. Stoichiometric calculations
A. Mole-to-mole conversions
B. Mass-to-mass conversions
C. Volume-to-volume conversions
1. Molar volume
2. Molarity.
D. Limiting reactants
E. Theoretical yields
F. Percent yields.

IX. Chemical bonding
A. Representing valence electrons with dots
B. Lewis structures of ionic compounds
C. Lewis structures of covalent compounds
D. Molecular shape: linear, trigonal planar, and tetrahedral geometries
E. Electronegativity and polarity.

OUTLINE OF COURSE LAB CONTENT
The course lab will address the following topics:

The following topics are included in the framework of the course but are not intended as limits on content. The order of presentation and relative emphasis will vary with each instructor.

I. Safety
A. Equipment
B. Practices
C. Personal protective equipment
D. Waste disposal.

II. Record keeping
A. Recording data
B. Laboratory reports.

III. Equipment
A. Glassware
B. Instruments.

IV. Measurement
A. Significant figures
B. Error
C. Accuracy vs. precision
D. Units.

V. Data analysis
A. Graphing
B. Problem solving
1. Dimensional analysis
2. Algebra.

VI. Standard chemical techniques
A. Separations
B. Solution making
C. Acid-based titration
1. Standardization
2. Indicators.

VII. Reaction chemistry
A. Experimental evidence
B. Determination of products
C. Writing and balancing equations.

VIII. Chemical calculations
A. Moles
B. Stoichiometry.

IX. Properties of substances
A. Descriptions
B. Nomenclature.

PERFORMANCE OBJECTIVES
Upon successful completion of this course, students will be able to do the following:

1). Use the scientific method and scientific reasoning to describe how controlled experiments are designed and carried out, to identify independent and dependent variables and describe correlations between them for given data sets and/or graphs, and to solve problems and perform calculations involving equations relating to physical and chemical quantities (e.g., density, atomic mass, theoretical yield), scientific notation, measurements, and unit conversions.
2). Analyze a given physical or chemical system to identify, describe, and explain how the component particles and forces of the atoms of a given element determine the properties of that element, including the electronic structure and periodic properties of elements, how the atoms interact with electromagnetic radiation, the types of bonding and properties of compounds the atoms will form, and the chemical reactions of substances containing the atoms.
3). Examine the composition of chemical substances and the components of chemical reactions to analyze, set up, and solve calculation problems (including stoichiometry) and to predict and explain the behavior of the system; balance a chemical reaction equation, and analyze and solve calculation problems involving the stoichiometry of the reaction.
4). Analyze a given chemical substance or mixture to identify and describe the type of bonding and/or the intermolecular forces and to predict properties of the system based on the bonding and/or intermolecular forces.
5). Apply chemical and physical principles to describe, predict, and explain the behavior of solids, liquids, gases, and solutions.
6). Use standard laboratory equipment, safety equipment, and instruments properly.
7). Record and manipulate measurement using the correct numbers of significant figures.
8). Analyze and critically discuss data, including graphs.
9). Perform standard chemical techniques such as separations, titration, and solution preparation.

READING ASSIGNMENTS
Reading assignments will be consistent with, but not limited by, the following types and examples:
1). Read textbook sections that deal with content topics.
2). Read articles in science periodicals and books and published on the Internet to complete individual and group homework assignments and research projects.
3). Examine and analyze arguments and explanations published in both print media (newspapers, books, magazine articles, etc.) and digital media concerning topics of interest involving physical and chemical principles and assess the conclusions expressed
4). Read the laboratory manual.
5). Read Material Safety Data Sheets (MSDS).

WRITING ASSIGNMENTS
Writing assignments will be consistent with, but not limited by, the following types and examples:

1). Construct and write cause and effect arguments and explanations, applying physical and chemical concepts to common phenomena, such as the following: explain how the properties of a chemical substance depends on the structure and bonding of the component atoms.
2). Analyze arguments and explanations published in both print and digital media concerning topics of interest involving physical and chemical principles and prepare a written assessment of the conclusions expressed.
3). Examine and analyze chemical systems in order to predict their behavior in given circumstances.
4). Perform calculations, including providing written descriptions of the processes used, involving chemical and physical systems and phenomena.
5). Prepare laboratory reports consisting of data, calculations, and answers to the questions in the manuals/packets.
6). Write a brief discussion evaluating the results of each experiment.

OUTSIDE-OF-CLASS ASSIGNMENTS
Outside-of-class assignments will be consistent with, but not limited by, the following types and examples:
1). Complete reading assignments to prepare for class and for individual and/or group projects.

2). Organize, assemble, and evaluate information from a number of sources (including both print and Internet sources), and use this information to produce either a thesis paper and/or a group project.
3). Complete calculations and other quantitative and qualitative problem-solving assignments.
4). Complete assignments given for each chapter covered in the textbook.
5). Prepare essays, group projects and presentations, and individual research paper.
6). Work in a group to discuss and analyze phenomena and to solve problems involving physical and chemical principles.
7). Complete problem solving exercises from the lab manual and/or instructor packets.
8). Conduct Internet searches related to information on chemicals using MSDS.

STUDENT LEARNING OUTCOMES

1. Student will be able to convert between different units using conversion factors and dimensional analysis.
2. Students will be able to predict the names and formulas of ionic and molecular compounds.
3. Students will be able to apply the principles of stoichiometry to perform calculations involving conversions between molar and mass quantities of substances.

METHODS OF INSTRUCTION
Instructional methodologies will be consistent with, but not limited by, the following types or examples:

1). Lecture presentations about the fundamentals of chemical phenomena and the applications of those principles to specific chemical systems.
2). Interactive chemical problem-solving sessions, including application of chemical principles to individual chemical systems, using active response methods (clickers, etc.).
3). Instructor-guided small group discussion on chemical principles and calculations.
4). Instructor-presented demonstrations of chemical reactions and other chemical principles, using specific examples.
5). Laboratory exercises and experimentation.

METHODS OF EVALUATION
Evaluation methodologies will be consistent with, but not limited by, the following types or examples:

1). Exams, tests, and/or quizzes, including multiple choice, short answer, cause-and-effect explanation, diagram, and calculation questions and problems, that deal with the scientific method and reasoning, principles of chemical structure and properties, chemical reactions, chemical nomenclature, and chemical ratios (stoichiometry).
2). Individual and/or group projects that emphasize the application of chemical principles to specific problems or situations, including research papers, group presentations, service learning in science classrooms, etc.
3). Written homework that illustrates and applies the chemical concepts and principles presented in lecture, discussion, the textbook, etc., including calculations, scientific reasoning, problem-solving and description, application, and explanation of concepts and phenomena.
4). Small group discussion and problem-solving sessions focusing on individual chemical principles and concepts conducted in class.
5). Laboratory exercises and reports.

REQUIRED TEXTBOOKS
Examples of typical textbooks for this course include the following:

1. Tro, Nivaldo J.. Introductory Chemistry. 5th ed., Pearson, 2014. 978-0321910073

OTHER REQUIRED INSTRUCTIONAL MATERIALS

1. Goggles (ANSI Z-87 standards)
2. MiraCosta Chemistry Department, Laboratory Manual for CHEM 140.
3. Basic Scientific Calculator

COURSE REPEATABILITY
Total Completions Allowed: 1

FULFILLS MIRACOSTA COLLEGE ASSOCIATE DEGREE REQUIREMENTS

Type of Approval: Hybrid Only
You may indicate here which component(s) of the course should never be conducted online (e.g. proctored exams, labs, in-person orientation, etc.): The experimental lab component of this course will not be conducted online.
MiraCosta General Education

Area B - Natural Sciences

IGETC Area 5: Physical and Biological Sciences (mark all that apply)

A: Physical Science
C: Laboratory

CSU GE Area B: Scientific Inquiry and Quantitative Reasoning

B1 - Physical Science
B3 - Laboratory Activity

ARTICULATION
Transfer Status: Acceptable for Credit: CSU, UC
CSU/IGETC GE Area(s): 120 - CSU, UC, CSU GE B1 & B3, IGETC 5A & 5c

THIS COURSE IS INCORPORATED INTO THE FOLLOWING PROGRAM(S)
AA Degree *CURRENT* Liberal Arts with an Area of Emphasis in Applied Health, Nutrition, and Kinesiology
AA Degree *CURRENT* Liberal Arts with an Area of Emphasis in Mathematics and Sciences
AS Degree *CURRENT* Engineering Technology
Certificate of Achievement *CURRENT* Engineering Technology

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